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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants: Ikuo URATANI et al.

Application No.: 10/769,784

Filed: February 3, 2004

For: DISK ARRAY APPARATUS, AND METHOD FOR
CONTROLLNG THE SAME

Group: 2188

Examiner: M. Padmanabhan

REQUEST FOR RECONSIDERATION

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

June 16, 2005

Sir:

In response to the Decision on Petition dated May 16, 2005, reconsideration and withdrawal of the Decision is respectfully requested in view of the following remarks.

REMARKS

Initially, in the Decision on Petition dated May 16, 2005, the Examiner asserts that the Petition to Make Special filed February 3, 2004 is defective because it argues that none of the references discloses "another disk array apparatus incapable of establishing a direct connection with the host computer", and that the independent claims actually recite "a disk array apparatus communicably connected to a host computer and/or another disk array apparatus incapable of establishing a direct connection with the host computer".

Applicants attach a Preliminary Amendment which amends the independent claims to further clarify the invention and recite "a disk array apparatus communicably connected to a host computer and another disk array apparatus incapable of establishing a direct connection with the host computer". Applicants respectfully request that these objections be withdrawn and that the Petition to Make Special filed April 22, 2005 be entered.

It is submitted that the cited references, whether considered alone or in combination, fail to disclose or suggest the invention as claimed. In particular, the cited references, at a minimum, fail to disclose or suggest in combination with the other limitations recited in the claims:

a first feature of the present invention as recited in independent claim 1 wherein another disk array apparatus incapable of establishing a direct connection with the host computer, a logical unit formation section for forming a plurality of logical units from the storage region of the addition result to be accessed by the host

computer, and a second check section for checking a validity of an instruction coming from the host computer for forming a pair between, out of the plurality of logical units, the logical unit formed from the storage region of the disk array apparatus and the logical unit formed from the storage region of the another disk array apparatus;

a second feature of the present invention as recited in independent claim 8 wherein another disk array apparatus incapable of establishing a direct connection with the host computer, a logical unit formation section for forming a plurality of logical units from the storage region of the addition result to be accessed by the host computer, and a check section for checking a validity of an instruction coming from the host computer for forming a pair between, out of the plurality of logical units, the logical unit formed from the storage region of the disk array apparatus and the logical unit formed from the storage region of the another disk array apparatus;

a third feature of the present invention as recited in independent claim 11 wherein another disk array apparatus incapable of establishing a direct connection with the host computer, a logical unit formation section for forming a plurality of logical units from the storage region of the addition result to be accessed by the host computer, and a check section for checking a validity of an instruction coming from the host computer for forming a pair between, out of the plurality of logical units, the logical unit formed from the storage region of the disk array apparatus and the logical unit formed from the storage region of the another disk array apparatus;

a fourth feature of the present invention as recited in independent claim 14

wherein a logical unit formation section for forming a plurality of logical units from the storage region of the addition result to be accessed by the host computer, a check section for checking a validity of an instruction coming from the first host computer for forming a pair between, out of the plurality of logical units, the logical unit formed from the storage region of the disk array apparatus and the logical unit formed from the storage region of the another disk array apparatus, and a prohibition section for, when a reading request comes from the second host computer for the data stored in the disk array apparatus and/or the another disk array apparatus, prohibiting the second host computer to make an access to the another disk array apparatus until a process ends after started responding to the data reading request;

a fifth feature of the present invention as recited in independent claim 17 wherein another disk array apparatus incapable of establishing a direct connection with the host computer, forming a plurality of logical units from the storage region of the addition result to be accessed by the host computer, and checking a validity of an instruction coming from the host computer for forming a pair between, out of the plurality of logical units, the logical unit formed from the storage region of the disk array apparatus and the logical unit formed from the storage region of the another disk array apparatus;

a sixth feature of the present invention as recited in independent claim 18 wherein another disk array apparatus incapable of establishing a direct connection with the host computer, a logical unit formation step of forming a plurality of logical units from the storage region of the addition result to be accessed by the host

computer, identifying information for a virtual device derived by virtualizing the storage region of the disk array apparatus, and retaining a mapping table showing an interrelation between the virtual device and the storage region of the another disk array apparatus mapped to the virtual device, and a check step of checking a validity of an instruction coming from the host computer for forming a pair between, out of the plurality of logical units, the logical unit formed from the storage region of the disk array apparatus and the logical unit formed from the storage region of the another disk array apparatus;

a seventh feature of the present invention as recited in independent claim 19 wherein another disk array apparatus incapable of establishing a direct connection with the host computer, forming a plurality of logical units from the storage region of the addition result to be accessed by the host computer, and checking a validity of an instruction coming from the host computer for forming a pair between, out of the plurality of logical units, the logical unit formed from the storage region of the disk array apparatus and the logical unit formed from the storage region of the another disk array apparatus; and

an eighth feature of the present invention as recited in independent claim 20 wherein a logical unit formation step of forming a plurality of logical units from the storage region of the addition result to be accessed by the host computer, checking a validity of an instruction coming from the first host computer for forming a pair between, out of the plurality of logical units, the logical unit formed from the storage region of the disk array apparatus and the logical unit formed from the storage region

of the another disk array apparatus, and when a reading request comes from the second host computer for the data stored in the disk array apparatus and/or the another disk array apparatus, prohibiting the second host computer to make an access to the another disk array apparatus until a process ends after started responding to the data reading request.

To the extent applicable to the present Petition, Applicants submit that although the distinguishing feature(s) may represent a substantial portion of the claimed invention, the claimed invention including said feature(s) and their inter-operation provides a novel storage system and system and method related to or implemented in or by said storage system not taught or suggested by any of the references of record.

The references considered most closely related to the claimed invention are briefly discussed below:

U.S. Patent No. 5,459,857 (Ludlam et al.) discloses a fault-tolerant disk array data storage subsystem in which two interconnected, dynamically-mapped disk drive array data storage subsystems emulate the operation of two storage control units sharing a single extremely reliable physical disk drive. The apparatus operates independent of the host processor and mimics the operation of a single DASD device even though the data is stored on a plurality of devices located in two operationally independent but cooperatively operative data storage subsystems. Mapping tables are used to indicate the correspondence between the virtual device image presented to the associated host processor and the physical storage location

on the plurality of disk drives in the redundancy group in which the associated data record is stored. This interconnection of the two data storage subsystems enables the host processor to access the data records even if one or more critical elements fail in the data storage subsystems or data channels that interconnect the host processor to the storage control units. The failure of a critical element is transparent to the host processor, since the data can be accessed via another data access path without requiring the system operator to perform any manual intervention activities. (See, e.g., Abstract and column 1, line 60, through column 2, line 43.) However, unlike the present invention, Ludlam et al. does not disclose, at a minimum, a logical unit formation section for forming a plurality of logical units from the storage region of the addition result to be accessed by the host computer, or a check section for checking a validity of an instruction coming from the host computer for forming a pair between, out of the plurality of logical units, the logical unit formed from the storage region of the disk array apparatus and the logical unit formed from the storage region of the another disk array apparatus. More particularly, Ludlam et al. does not disclose or suggest the above described first feature of the present invention as recited in independent claim 1, the above described second feature of the present invention as recited in independent claim 8, the above described third feature of the present invention as recited in independent claim 11, the above described fourth feature of the present invention as recited in independent claim 14, the above described fifth feature of the present invention as recited in independent claim 17, the above described sixth feature of the present invention as recited in independent

claim 18, the above described seventh feature of the present invention as recited in independent claim 19 and the above described eighth feature of the present invention as recited in independent claim 20, in combination with the other limitations recited in each of the independent claims.

U.S. Patent No. 5,581,724 (Belsan et al.) discloses a memory control apparatus for a disk drive array data storage subsystem that employs a log-structured storage management approach that maintains data integrity while writing data to multiple open de-stage cylinders on the disk drives. The data storage subsystem dynamically maps a virtual data storage device image presented to associated processors to physical data storage devices used to implement the data storage subsystem. Multiple de-stage memory elements are concurrently active to increase an aggregate de-stage data transfer rate and to allow the data to be stored on various memory elements appropriate to the type of data contained in each stored virtual object. The data storage subsystem maintains mapping tables which indicate the mapping that takes place between the virtual device image as seen by the host processors and the actual physical devices on which the data is stored. In order to improve the performance of the data storage subsystem, data that is modified by a host processor is not rewritten in its original storage location, since this would entail updating the redundancy data that is stored along with the data received from the associated data processor in the redundancy group. (See, e.g., Abstract and column 2, lines 2-64.) However, unlike the present invention, Belsan et al. does not disclose, at a minimum, a check section for checking a validity of an instruction

coming from the host computer for forming a pair between, out of the plurality of logical units, the logical unit formed from the storage region of the disk array apparatus and the logical unit formed from the storage region of the another disk array apparatus. More particularly, Belsan et al. does not disclose or suggest the above described first feature of the present invention as recited in independent claim 1, the above described second feature of the present invention as recited in independent claim 8, the above described third feature of the present invention as recited in independent claim 11, the above described fourth feature of the present invention as recited in independent claim 14, the above described fifth feature of the present invention as recited in independent claim 17, the above described sixth feature of the present invention as recited in independent claim 18, the above described seventh feature of the present invention as recited in independent claim 19 and the above described eighth feature of the present invention as recited in independent claim 20, in combination with the other limitations recited in each of the independent claims.

U.S. Patent No. 5,742,792 (Yanai et al.), discloses a system and method for automatically providing and maintaining a copy of mirrored data stored at a location that is geographically remote from the main storage device. The two data storage systems are interconnected by a data link for remote mirroring of data. Each volume of data is configured as a local, a primary in a remotely-mirrored volume pair, or a secondary in a remotely-mirrored volume pair. The system controls storing of primary data received from a primary host computer on a primary data storage

system, and additionally controls the copying of the primary data to a secondary data storage system controller which forms part of a secondary data storage system, for providing a back-up copy of the primary data on the secondary data storage system, which is located in a geographically remote location from the primary data storage system. The high speed communication link also permits one data storage system to read or write data to or from the other data storage system. (See, e.g., Abstract and column 2, line 29, through column 3, line 19.) However, unlike the present invention, Yanai et al. does not disclose, at a minimum, a second disk array apparatus incapable of establishing a direct connection with the host computer, or a check section for checking a validity of an instruction coming from the host computer for forming a pair between, out of the plurality of logical units, the logical unit formed from the storage region of the disk array apparatus and the logical unit formed from the storage region of the another disk array apparatus. More particularly, Yanai et al. does not disclose or suggest the above described first feature of the present invention as recited in independent claim 1, the above described second feature of the present invention as recited in independent claim 8, the above described third feature of the present invention as recited in independent claim 11, the above described fourth feature of the present invention as recited in independent claim 14, the above described fifth feature of the present invention as recited in independent claim 17, the above described sixth feature of the present invention as recited in independent claim 18, the above described seventh feature of the present invention as recited in independent claim 19 and the above described eighth feature of the

present invention as recited in independent claim 20, in combination with the other limitations recited in each of the independent claims.

U.S. Patent No. 6,356,977 (Ofek et al.) discloses a system and method for providing data migration between two data storage devices. The system includes a first data storage device and a second data storage device. The first and second data storage devices are connected as a composite storage device that is coupled to a host, network, or other data processing system. The second storage device includes a table which identifies data elements that have migrated over to the second data storage device from the first data storage device. If the data elements have migrated, the second storage device responds to the data transfer request independently of any interaction with the existing storage device. If the data elements have not migrated, the second storage device migrates the requested data elements and then responds to the data request and updates the data element map or table. When not busy servicing other requests, the second storage device operates in a background mode to migrate data elements so the data migration can occur concurrently with and transparently to system operations. (See, e.g., Abstract and column 2, line 19, through column 4, line 47) However, unlike the present invention, Ofek et al. does not disclose, at a minimum, a second disk array apparatus incapable of establishing a direct connection with the host computer, or a check section for checking a validity of an instruction coming from the host computer for forming a pair between, out of the plurality of logical units, the logical unit formed from the storage region of the disk array apparatus and the logical unit formed from

the storage region of the another disk array apparatus. More particularly, Ofek et al. does not disclose or suggest the above described first feature of the present invention as recited in independent claim 1, the above described second feature of the present invention as recited in independent claim 8, the above described third feature of the present invention as recited in independent claim 11, the above described fourth feature of the present invention as recited in independent claim 14, the above described fifth feature of the present invention as recited in independent claim 17, the above described sixth feature of the present invention as recited in independent claim 18, the above described seventh feature of the present invention as recited in independent claim 19 and the above described eighth feature of the present invention as recited in independent claim 20, in combination with the other limitations recited in each of the independent claims.

U.S. Patent No. 6,557,089 (Reed et al.) discloses an automated, fault-tolerant method of creating a backup copy of a source direct access storage device volume by first performing an instant virtual copy with source volume identifier suspended, then creating a non-virtual (physical) backup copy from the instant copy with the source volume ID reintroduced. This creates an exact duplicate of the source volume with minimal impact on access to the source volume. Moreover, the resultant backup copy is less costly and error prone because it is created by a machine-automated process rather than various commands issued by a system administrator. (See, e.g., Abstract and column 2, line 64, through column 3, line 55.) However, unlike the present invention, Reed et al. does not disclose, at a

minimum, a second disk array apparatus incapable of establishing a direct connection with the host computer, or a check section for checking a validity of an instruction coming from the host computer for forming a pair between, out of the plurality of logical units, the logical unit formed from the storage region of the disk array apparatus and the logical unit formed from the storage region of the another disk array apparatus. More particularly, Reed et al. does not disclose or suggest the above described first feature of the present invention as recited in independent claim 1, the above described second feature of the present invention as recited in independent claim 8, the above described third feature of the present invention as recited in independent claim 11, the above described fourth feature of the present invention as recited in independent claim 14, the above described fifth feature of the present invention as recited in independent claim 17, the above described sixth feature of the present invention as recited in independent claim 18, the above described seventh feature of the present invention as recited in independent claim 19 and the above described eighth feature of the present invention as recited in independent claim 20, in combination with the other limitations recited in each of the independent claims.

U.S. Patent No. 6,832,289 (Johnson) discloses a method and system for migrating data from a first disk storage subsystem to a second heterogeneous disk storage subsystem without interrupting access to the data and without requiring special hardware. The computer system has memory in a processor and a plurality of attached heterogeneous disk storage systems. Data is copied from a first disk

storage subsystem to a second disk storage subsystem, of equal or greater capacity to the first subsystem. An application program is able to access the data on the first disk storage subsystem while the data is being copied. The volume of data on the second disk storage subsystem is identified, within the computer system, as the volume of data on the first disk storage subsystem after the data is copied. (See, e.g., Abstract and column 2, lines 57, through column 4, line 14.) However, unlike the present invention, Johnson does not disclose, at a minimum, a second disk array apparatus incapable of establishing a direct connection with the host computer, or a check section for checking a validity of an instruction coming from the host computer for forming a pair between, out of the plurality of logical units, the logical unit formed from the storage region of the disk array apparatus and the logical unit formed from the storage region of the another disk array apparatus. More particularly, Johnson does not disclose or suggest the above described first feature of the present invention as recited in independent claim 1, the above described second feature of the present invention as recited in independent claim 8, the above described third feature of the present invention as recited in independent claim 11, the above described fourth feature of the present invention as recited in independent claim 14, the above described fifth feature of the present invention as recited in independent claim 17, the above described sixth feature of the present invention as recited in independent claim 18, the above described seventh feature of the present invention as recited in independent claim 19 and the above described eighth feature of the

present invention as recited in independent claim 20, in combination with the other limitations recited in each of the independent claims.

U.S. Patent Publication No. 2003/0188114 (Lubbers et al.) discloses a data replication method and system where both the source and destination data storage devices are virtualized at a system level such that both source and destination virtual disks are implemented by a plurality of physical storage devices. A storage cell and storage controller is implemented at each site and a pool of physical storage is coupled to the controller. A copy set comprising a logical unit of storage in each of the storage cells is defined. As operational data transactions are performed to one of the members of a copy set, they are replicated in each other member of the copy set. Changes to dependent attributes of one member of a copy set are replicated to each other member of the copy set. Changes to independent attributes can be made independently of the other members of the copy set. (See, e.g., paragraphs 13-14, and 21.) However, unlike the present invention, Lubbers et al. does not disclose, at a minimum, a second disk array apparatus incapable of establishing a direct connection with the host computer, or a check section for checking a validity of an instruction coming from the host computer for forming a pair between, out of the plurality of logical units, the logical unit formed from the storage region of the disk array apparatus and the logical unit formed from the storage region of the another disk array apparatus. More particularly, Lubbers et al. does not disclose or suggest the above described first feature of the present invention as recited in independent claim 1, the above described second feature of the present invention as recited in

independent claim 8, the above described third feature of the present invention as recited in independent claim 11, the above described fourth feature of the present invention as recited in independent claim 14, the above described fifth feature of the present invention as recited in independent claim 17, the above described sixth feature of the present invention as recited in independent claim 18, the above described seventh feature of the present invention as recited in independent claim 19 and the above described eighth feature of the present invention as recited in independent claim 20, in combination with the other limitations recited in each of the independent claims.

U.S. Patent Publication No. 2004/0049643 (Alavarez et al.) discloses a computer storage system that includes a first storage device and a second storage device, in which a controller performs data operations to copy data from the first storage device to the second storage device, so that a redundant copy is kept in the second storage device. The invention includes a method for receiving a request to perform a data operation; determining whether the request provokes a write operation on the storage device, and then writing the data to the first storage device and a copy of the data to the second storage device. (See, e.g., Abstract and paragraphs 10-11.) However, unlike the present invention, Alavarez et al. does not disclose, at a minimum, a second disk array apparatus incapable of establishing a direct connection with the host computer, or a check section for checking a validity of an instruction coming from the host computer for forming a pair between, out of the plurality of logical units, the logical unit formed from the storage region of the disk

array apparatus and the logical unit formed from the storage region of the another disk array apparatus. More particularly, Alavarez et al. does not disclose or suggest the above described first feature of the present invention as recited in independent claim 1, the above described second feature of the present invention as recited in independent claim 8, the above described third feature of the present invention as recited in independent claim 11, the above described fourth feature of the present invention as recited in independent claim 14, the above described fifth feature of the present invention as recited in independent claim 17, the above described sixth feature of the present invention as recited in independent claim 18, the above described seventh feature of the present invention as recited in independent claim 19 and the above described eighth feature of the present invention as recited in independent claim 20, in combination with the other limitations recited in each of the independent claims.

Therefore, since the cited references fail to disclose or suggest the above described first feature of the present invention as recited in independent claim 1, the above described second feature of the present invention as recited in independent claim 8, the above described third feature of the present invention as recited in independent claim 11, the above described fourth feature of the present invention as recited in independent claim 14, the above described fifth feature of the present invention as recited in independent claim 17, the above described sixth feature of the present invention as recited in independent claim 18, the above described seventh feature of the present invention as recited in independent claim 19 and the above

described eighth feature of the present invention as recited in independent claim 20, described eighth feature of the present invention as recited in independent claim 20, in combination with the other limitations recited in each of the independent claims, it is submitted that all of the claims are patentable over the cited references whether said references are taken individually or in combination with each other.

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Respectfully submitted,

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